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ABSTRACT

This study on malnutrition as a limiting factor in the development of education (and, hence, in socioeconomic development generally) was presented to the UNESCO Seminar on Education, Nutrition, Agriculture and Man. The paper reports on recent research showing that the development of the central nervous system in very young children (including the period of gestation) is realized at a sub-optimal level if the child, particularly before age 3, should suffer from nutritional deficiencies, especially animal protein and vitamins. The paper poses these questions: (1) Is malnutrition during the early years of life a decisive limiting factor in the development of education among economically and socially disadvantaged segments of society in developing and industrialized countries alike? (2) Are 2/3 to 3/4 of the children in developing countries probably not suffering from malnutrition (fully half to an extreme degree) during their first years of life? (3) Are overall food (particularly protein) shortages not far less the cause of present inadequate child feeding in disadvantaged communities than lack of awareness, by those who feed the children, of the consequences and implications of defective child nutrition? Sections on planning a research program and possibilities for immediate corrective action follow discussion of the issue. (Author/KM)

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U. S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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This study on the subject of malnutrition as a limiting factor in the development of education (and, hence, in socio-economic development generally) is made available to participants with a view to provoking thought on the broad implications of insufficient food production - and, particularly, of deficient patterns in food consumption - in developing countries.

The paper reports on recent research which shows that the development of the central nervous system amongst children of very young age (including the period of gestation) is realized at a sub-optimal level if the child - particularly before age 3 - should happen to suffer from nutritional deficiencies, with special regard to animal protein and vitamins.

PS 006313

SCIENTIFIC STUDY OF

MALNUTRITION AS A LIMITING FACTOR

IN THE DEVELOPMENT OF EDUCATION

by

Alfredo Picasso de Oyagüe

1. A meaningful and rather accusing amount of public attention, in many countries, is currently focused on the ethical and social role of science.

2. The world press and learned journals alike are highlighting, almost daily of late, the disillusionment of young people (not least young scientists) over the accent still being given to the development of even more apocalyptic weapons, rather than to rational concentration of scientific activity in the search for better solutions to fundamental human problems[1/].

3. Severe criticism is, besides, being voiced about the apparent low propensity of "exact" and "social" scientists to cooperate with one another in the study of issues - usually human - which sit squarely on the sectorial razor's edge.

4. It could be, therefore, that not nearly enough is being done to orient national and international science policies towards the identification and the organization of scientific research and experimental development projects likely to contribute to mankind's well-being.

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1/ Revised version of the paper originally presented to the Unesco Monthly Socio-Economic Seminar, on 29 January 1971. The views expressed are solely those of the author.

2/ Cf., for instance, the recent surprisingly passionate exchanges about intelligence and race, in The Atomic Scientist; or "Scientists in varied fields join in attacking national problems", New York Times, 5 October 1970.

5. Intended, as it is, to throw open for discussion one such project, the present paper poses the following questions:

- Is malnutrition during the early years of life - say through age 3 or 4 - a decisive limiting factor in the development of education amongst economically and socially disadvantaged segments of society in developing and industrialized countries alike?

- Are two-thirds to three-fourths of the children of developing countries probably not suffering from malnutrition, of which fully half to an extreme degree, during their first years of life?

- Are overall food (particularly protein) shortages not far less the cause of present inadequate child feeding in disadvantaged communities, than lack of awareness - by those who feed the children - of the consequences and implications of defective child nutrition?

6. A revised version of this paper will be prepared in the light of such replies as might be received to these questions, and thanks for replies are extended in advance. Since the paper also seeks to identify possible remedial action, it comprises three parts:

I. The issue.

II. Planning a research programme.

III. Possibilities for immediate corrective action.

I. THE ISSUE

7. The brain, together with the spinal cord, constitute man's complete central nervous system. The coordinated end result of neural processes, as influenced by "environment", is called "behaviour".

8. The "social and behavioural sciences" - of which the sciences of communication (inter-personal and mass), psychological behaviour and physiological behaviour are but fractions - are thus all concerned with explaining neural phenomena.

9. These sciences are, however, essentially concerned with the study of normal situations, causes and effects. Pathological aspects properly belong to the medical sciences. "Borderline" cases tend to be neglected, because no specific scientific branch identifies itself easily with them.

10. The subject of the present paper is, as will be seen, in our opinion, such a "borderline" case. It is perhaps because of this that it has been somewhat overlooked, particularly as an element to reckon with in educational philosophy, theory, planning and action.

11. In any event, we did not succeed in locating a single detailed analysis of the educational implications[1]. Nevertheless, steady headway has been made thanks to the unswerving efforts of a small group of scientists [2].

12. A first salient problem is to attempt to define "normality, in relation to malnutrition, at an early stage in life, including life before birth.

13. That is a difficult problem. Nutrition affects the development of the entire human body, not just the nervous system. However, since reference is here made primarily to brain functions, which have the most direct relationship with education, a word about the brain seems to be in order.

14. What science knows about the brain, for sure, is not much, but sufficient for the purposes of the present paper.

15. The "standard" human brain is made up of more than 10^{12} cells, contact points (synapses) more numerous still, allowing the passage of messages (impulses) between cells, by highly selective and otherwise extraordinarily complex processes which man will not fully understand for some time to come, if ever.

1/ A modest study carried out by the author of the present paper is described in paragraphs 66 to 68.

2/ Cf. "Malnutrition in Infancy and Childhood", by Federico Gomez, Rafael Ramos Galvan, Joaquin Cravioto and Silvestre Frenk, in Advances in Pediatrics, Vol. VII, 1955; and compare with articles by some of these and other contributors, to Malnutrition, Learning and Behaviour, Edited by Nevin S. Schrimshaw and John E. Gordon, M.I.T. Press, 1968.

16. If malnutrition should, as it does, restrict the growth of neural cells, or lessen their quality, or disrupt the optimal development of synapses and the complex processes whereby messages are conveyed by them, or lead to a defective system for the irrigation (nourishment) of the cells and for the elimination of waste by them, it will reduce the nature-intended effectiveness of the neural system as a whole.

17. Science knows, moreover, that the effects of malnutrition on an individual, while he is in his mother's womb and through the age of 6, with emphasis on the period through the first 2 - 3 years, are likely to be much more harmful than malnutrition at a succeeding age, particularly in connexion with the ability to learn, remember, perceive and act in a coordinated manner. Early losses might be irretrievable.

18. These facts are illustrated, in their very crudest form, by the graph on page 5, which illustrates the growth of cranial circumference from inception to 20 years of age. By the time that an individual is supposed to enter kindergarten, by far the major part of the growth of his central nervous system, and the "programming" of its future development, will have taken place.

19. By the time the individual is ready to enter primary school, the life characteristics of his central nervous system will have been almost wholly determined.

20. The implications for education in all its forms (intellectual training and physical education) would appear to be self-evident. Neither can one aspect be dissociated from the other: "mens sana in corpore sano".

21. The exact extent of minimization of neural capacity, at various ages, in response to given degrees of malnutrition, has not as yet been determined. But such material as is available, as well as conversations with a number of leading scientists in different related disciplines, strongly suggest that even a small degree of continuous malnutrition, during early human life, cannot but severely jeopardize normal development of the neural system, in various ways, tentatively discussed below:

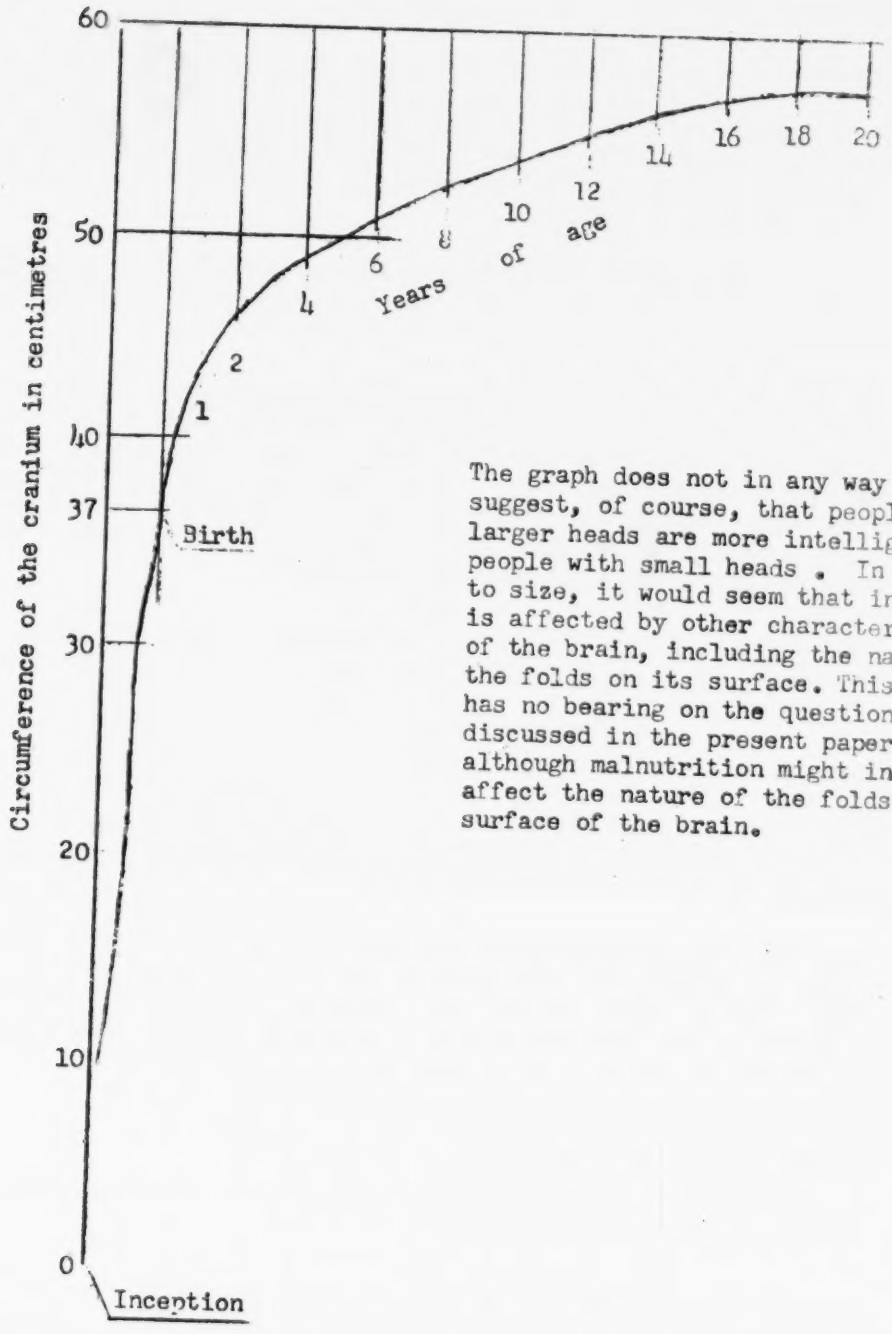
22. Severe illness or malnutrition of the mother may, first of all, upset growth of the fetus (as is widely known, some drugs - such as thalidomide - have that consequence.)

23. Assuming that everything went perfectly well during gestation, the infant's central nervous system will possess, upon birth, to its own pre-determined full potential, numerous inherited traits which condition its possible ulterior development (e.g. normal and optimal growth of capacity).

24. The child's inherited neural potential cannot be maximized, at the present time, through the application of scientific knowledge, though research is already under way which may some future day lead to possibilities of "genetic surgery". Neither can "experience" maximize neural potential; it merely "impresses" the brain to the extent that its potential allows. Some "impressions", combined with others, give rise to new "impressions". "Experience" is therefore a cumulative, inter-related and complex process.

Graph I

GROWTH OF THE CIRCUMFERENCE OF THE CRANIUM 1/



The graph does not in any way suggest, of course, that people with larger heads are more intelligent than people with small heads. In addition to size, it would seem that intelligence is affected by other characteristics of the brain, including the nature of the folds on its surface. This aspect has no bearing on the questions discussed in the present paper, although malnutrition might indeed affect the nature of the folds on the surface of the brain.

PS 0063 13

1/ The purpose of this graph is merely to show the steep rise in growth of the circumference of the cranium during early life. Indication of this growth in centimetres is for illustrative purposes only, since optimal growth of the cranium varies from person to person and according to ethnic characteristics. The cranial ratio (ratio of width of skull to its length) is similarly subject to normal variation.

25. In other words, every child (with the possible exception of identical twins) is born with a different pre-determined (and even "pre-wired") neural potential.

26. The implication is that differences - which may be extreme - exist, at birth, in inherited neural potential. In this sense, all children are definitely not born equal. While some are born with a genetic potential to become "a genius", or to become capable of running one mile in 3 minutes, others are born less gifted and could never surpass potentials higher than those given to them by nature.

27. Whether the genetically-inherited neural potential is completely realized after birth (which it very seldom is) depends on two main sets of factors, both of which bristle with hazards.

28. On the one hand, there are many environmental factors, both bad and good, (including learning at home and in school, influence of the mass media, opportunity for exercise and sports, etc). These factors will play, particularly after the age of 3, a very important role in determining the extent to which neural potential is realized, for bad or good. Far from this paper to suggest that this set of factors is unimportant, and reference to its great importance will be made later on.

29. But what of the other main set of factors - the need of the human body, from inception, for housing, clothing and nutrition adequate for its optimal physical growth and sustenance? Can this set of factors, particularly during the crucial years of neural development to age 6, be neglected? Or can its importance be underestimated in terms of educational planning, development or efficiency? Of course not, all the more so since the fact that neural development mainly takes place in pre-school years suggests that the environmental factors cannct exercise their full influence, for good or bad, after age 6, if optimal neural growth has not taken place before age 6.

30. For the sake of scientific accuracy, we underline, in the preceding paragraph, the meaning of "for good or bad". Direly undernourished individuals may be "good idiots" and supremely well fed ones may be "evil geniuses". The physical scale of values should not be confused with the ethical scale, or with moral values, which lie elsewhere.

The consequences of malnutrition

31. A word must be added about the consequences of malnutrition, with special reference to education.

32. Severe malnutrition during early life is likely to lead to brains having less or inadequately developed brain cells. Moreover, brains

which have developed under severe conditions of undernourishment probably suffer from other forms of underdevelopment than mere minimization of the cells, for, as already mentioned, the proper functioning of the brain depends on the development, under optimal conditions, of many inter-related components and processes, the complexity of which defeats imagination.

33. In other words, if an individual should suffer from malnutrition during gestation and during his early childhood, his inherent educational potential will not be realized, and his educational capacity will, as time passes and he becomes older, be less than what it should have been at each subsequent given age.

34. It is difficult enough to entertain the idea that a single individual can have thus been "artificially minimized", against nature's intentions, and scandalous to think that two-thirds to three-fourths of the children of developing countries, plus certain segments of the population of industrialized nations, are probably affected. Surely the consequences of such a situation, if it were to be confirmed by the research programme proposed in Part II below, are of world import, both in practical as well as in ethical terms.

35. If the above hypothesis is confirmed, the main implication would be, in our opinion, that early education in the communities concerned cannot but be kept at an artificially low level, lest an effort to impose a higher, normal level lead to huge school drop-out and repetition rates (as there is evidence that it does). Educational reform intended to raise the level of instruction for a given age level, by introducing more difficult subject matter in more subtly taught ways and with the use of the latest pedagogical techniques, would appear to be very difficult under such adverse conditions.

36. Another serious implication stems from the influence of environment on the learning process. Environment does not by any means only include the quality of the teacher and the classroom, or the quality of educational tools. It also means the average quality of the pupils themselves. How can a naturally gifted pupil be expected to perform optimally, in intellectual terms, if he is surrounded by a majority of fellow pupils who impose a generally dull intellectual climate within the classroom? Nor can teachers swamped with pupils (and who in developing countries often attempt to teach pupils of different grades within one same classroom) be expected to do anything which will significantly alter the general inefficiency thus resulting from early education. While there will be exceptions - arising from the capacity of really extraordinary and tenacious pupils or of truly exceptional teachers, - these are likely to be so few as not to change the course of personal (and social) fulfillment.

37. A further aggravating factor is that in developing communities the possibilities of "out-of-school" education (from parents, other adults, other children and the mass media of information) are far more limited than in industrialized countries.

38. On the subject of consequences, a final word might be added about the impact on development plans and on returns from educational investment. Major designs such as the United Nations Second Development Decade foresee the incorporation, into primary school, of all of the world's children of primary-school age, by 1980. Together with the attainment of other educational goals, achievement of this target presumes that the developing countries of Africa, Latin America, Asia and the Arab region, will increase their total educational expenditure from about 9.160.000.000 dollars in 1966, to 24.000.000.000 dollars in 1980; or an average of about 16.000.000.000 dollars annually in 1965 to 1980: or a total investment of 240.000.000.000 dollars in 15 years.

39. How much of this is likely to be wasted if we do not fully investigate the factors which condition optimal growth of children before they enter school? Children are, after all, the "raw material" of education; the object of and justification for education. Moreover, education is a life-long process. And what to say about the consequences of malnutrition on the performance of individuals throughout life, as measured against their inherited potential performance? A part of the answers to these complex questions may be found in Tables 1, 2, 3 and 4 which appear on pages 9 to 11 of the present paper.

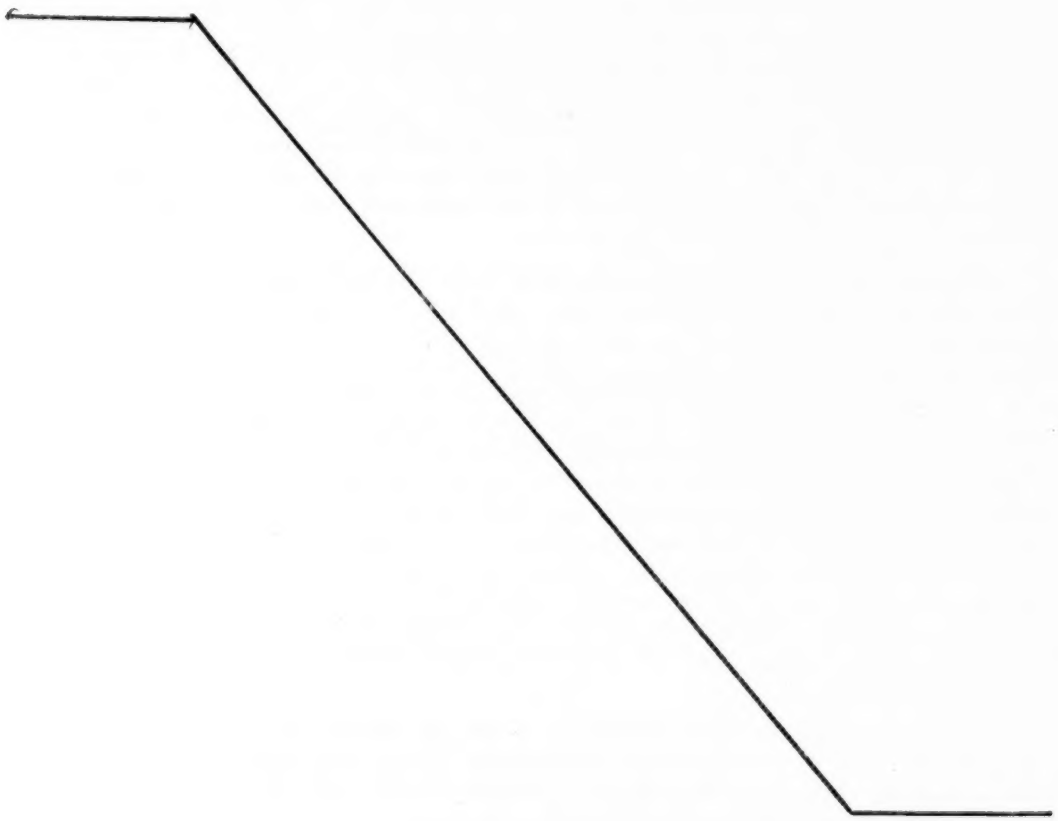


Table 1. Public expenditure on education, 1960 and 1965 - 1968 (millions US dollars - in current prices) Revised

Major regions	1960	1965	1966	1967	1968
WORLD TOTAL 1)	54 350	96 360	106 980	119 090	131 640
AFRICA	1 110	1 660	1 920	2 170	2 370
NORTHERN AMERICA	22 670	39 740	44 050	49 940	56 510
LATIN AMERICA	1 880	3 230	3 670	4 000	4 430
ASIA 1)	3 710	7 380	8 370	9 470	10 660
EUROPE AND USSR	24 380	43 280	47 660	52 110	56 220
OCEANIA	600	1 070	1 310	1 400	1 450
(ARAB STATES)	(700)	(1 020)	(1 100)	(1 210)	(1 340)
DEVELOPED COUNTRIES	49 450	88 190	97 820	108 670	120 290
DEVELOPING COUNTRIES	4 900	8 170	9 160	10 420	11 350

1) Not including China (mainland), Democratic People's Republic of Korea, and Democratic Republic of Viet-Nam.

Table 2. Public expenditure on education 1960 - 1968 (annual increase in percent; current prices) Revised

Major regions	1960-1965	1965-1966	1966-1967	1967-1968	1960-1968
WORLD TOTAL 1)	12.1	11.0	11.3	10.5	11.7
AFRICA	8.4	15.7	13.0	9.2	10.0
NORTHERN AMERICA	11.9	10.8	13.4	13.2	12.1
LATIN AMERICA	11.4	13.6	9.0	10.8	11.3
ASIA 1)	14.7	13.4	13.1	12.6	14.1
EUROPE AND USSR	12.2	10.1	9.3	7.9	11.0
OCEANIA	12.3	22.4	6.9	3.6	11.7
(ARAB STATES)	(7.8)	(7.8)	(10.0)	(10.7)	(8.5)
DEVELOPED COUNTRIES	12.3	10.9	11.1	10.7	11.8
DEVELOPING COUNTRIES	10.8	12.2	13.8	8.9	11.1

1) See note 1 in the above table.

Source: Office of Statistics, Unesco.

Table 3. Gross National Product, Military Expenditure and Public Expenditure on Education and Health 1967 (absolute amounts in U.S. dollars and as percentage of GNP)

Major regions	GNP		Military Expenditure		Public Expenditure on Education		Public Expenditure on Health	
	mil. US $	%	mil. US $	%	mil. US $	%	mil. US $	%
WORLD [1]	2 395 300	100	172 582	7.2	119 090	5.0	58 735	2.5
AFRICA	52 000	100	1 727	3.3	2 170	4.2	784	1.5
NORTHERN AMERICA	850 900	100	77 301	9.1	49 940	5.9	19 662	2.3
LATIN AMERICA	110 300	100	2 468	2.2	4 000	3.6	1 927	1.7
ASIA [1]	249 600	100	7 150	2.9	9 470	3.8	1 263	0.5
EUROPE AND USSR	1 101 500	100	82 676	7.5	52 110	4.7	34 604	3.1
OCEANIA	31 000	100	1 260	4.1	1 400	4.5	495	1.6
(ARAB STATES)	(25 900)	(100)	(1 854)	(7.2)	(1 210)	(4.7)	(583)	(2.3)
DEVELOPED COUNTRIES	2 102 800	(100)	162 741	7.7	108 670	5.2	54 946	2.6
DEVELOPING COUNTRIES	292 500	(100)	9 841	3.4	10 420	3.6	3 789	1.3

1) Not including China (mainland), Democratic People's Republic of Korea and Democratic Republic of Viet-Nam.

Sources

GNP — Estimates based on the relevant U.N. publications.

Military expenditure: United States Arms Control and Disarmament Agency : World Military Expenditures 1969, Washington D.C.

Education expenditure: UNESCO questionnaire on educational finance and expenditure.

Health expenditure: World Health Organization (WHO), published in : World Military Expenditure 1969, op.cit.

Note : For the conversion from national currencies into U.S. dollars official exchange rates were used for most of the national totals. Alternative rates were used for the socialist countries and for several countries in Latin America and Asia for which official rates appeared to yield unrealistic equivalents. In addition, different conversion factors were used in some cases, for GNP, military expenditure, education expenditure and health expenditure in order to make the respective dollar values more comparable to U.S. values. The proportions of GNP of the various types of expenditure are consequently not fully comparable.

Compiled by: Office of Statistics, Unesco.

Table 4. Public expenditure on education as % of GNP

A suitable and currently used means of measuring educational efforts expressed in monetary terms is to show them in relation to the total amount of available resources, i.e. the gross national product (GNP). The proportion of GNP represented by public expenditure on education has been calculated for 85 countries for which sufficiently reliable data were available - 31 developed countries and 54 developing countries. It should be noted that the averages established for the individual years are unweighted averages whereby large countries, such as the U.S.A. or India, carry the same weight as smaller countries, such as Luxembourg or Botswana.

Public expenditure on education as % of GNP
1960 and 1965-1968 (unweighted averages)

	No. of countries covered	1960	1965	1966	1967	1968
World	(85)	3.02	3.75	3.83	4.08	4.24
Developed countries	(31)	3.52	4.45	4.55	4.73	4.80
Developing countries	(54)	2.73	3.35	3.42	3.72	3.91

The survey shows that the relevant proportions have continuously risen since 1960. This applies to developed as well as to developing countries. The world average rose from 3.02% in 1960 to 4.24% in 1968. The developed countries spent 3.52% of their GNP on education in 1960, as compared to 4.80% in 1968. The proportions for the developing countries were 2.73% and 3.91% respectively. However, in spite of the efforts of the developing countries, the gap between developed and developing countries remained more or less the same.

II. PLANNING A RESEARCH PROGRAMME

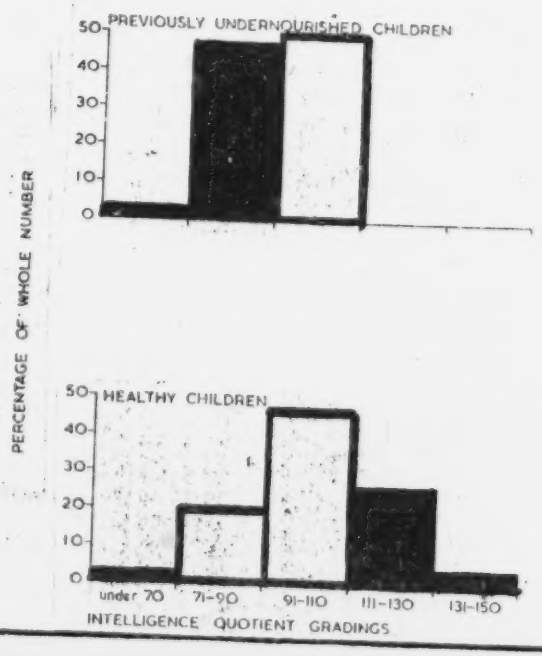
40. It would seem of primordial importance that the world know full answers to the questions posed in para. 5 and to the multitude of further and subsidiary questions which will doubtless be raised by these answers. Research begets research.

41. While no single institution or individual today possesses full answers to the questions, many bits of scattered and as yet unrelated scientific data must exist in published or unpublished form. But it must be welded together.

42. The basis for planning a research programme might therefore be an appeal to the world scientific community, and to anyone else who believes he has useful information (teachers, in particular), to volunteer it, for scientific analysis.

43. It is here suggested that the world appeal might be launched in 1971, with a view to the bringing together and broadly classifying, during 1972, the data thus assembled. This might be done by an appropriate organization - such as Unesco - possibly with a grant (about $100,000 should suffice) from banking or philanthropic sources. Analysis of the data, by whoever undertakes it, would require close contact with all other directly interested organizations. An evaluation of all previously conducted, related studies would need to be included in this work. For instance, to what extent are the results indicated in the Graph, below, applicable to the situation encountered in the developing nations ?

Graph I. Distribution of quotients of intelligence of 36 undernourished Serbian children, as compared with standards established for Serbian children of similar origin and environment, but who had no history of malnutrition



"Effect of Undernutrition in Early Life on Physical and Mental Development"
by
Vera Cabak and R. Najdanvic,
Paediatric Clinic, Sarajevo, Yugoslavia
published in Arch. Dis. Childh. 1965, 40, 532.

44. During 1972, and in the light of response to the world appeal, further research plans for 1972-1980 might be drawn up by interested institutions, the effort of which would need to be effectively guided by a coordinated structure of inter-disciplinary consultative panels of scientists.

45. Aware, as we are, of the complexity of organizing an effective research programme on this multifarious issue, it might seem premature to advance any concrete plan for a long-term research programme. Scientific work, however, is based on a process of successive approximation to reality, and someone always has to cast the first stone.

46. With all due sense of limitation and advance thanks for suggestions for improvement, a tentative proposal for a three-phased research programme is therefore made below:

47. It would first seem necessary to define the aim of the research programme. In our opinion, the definition might be:

" To evaluate the present and the possible future implications of inadequate pre-school feeding in socially and economically disadvantaged segments of society in all countries; and to identify, and when necessary develop, practical low-cost forms of remedial action."

48. The two-fold reason why it is suggested that the programme should not be limited to feeding up to a specific given age (say 2 or 3 years, when most neural development takes place) is:

firstly: that the ultimate purpose of the research, as we understand it, is to promote operational activity. The appropriate operational "cut-off" point, it seems to us, is the day when the individual first enters school to stay. Whether this will mean pre-primary or primary school, as well as the age at which this will happen, will vary considerably, from country to country and community to community, according to legislation and circumstances; but this matters little.

As will be realized, the assumption is that once school life takes over, adequate child feeding will become a responsibility more of the State than of the individual (this, of course, might be a major assumption in developing countries). In any event, as the present paper suggests, what happens to growth of the physical neural attribute after school entrance age is far less important than what happens before that age.

Second: work on high altitude (Andean Indian) biology, our own observations amongst Guatemalan indians, and talks with medical doctors who have worked in Africa, lead us to tentatively believe that the rythm of neural development (curve flatter than that in the graph, with ultimate potential unchanged) might be slower for certain ethnic groups than for others. In other words, one of nature's wonderful compensations is, perhaps, to give the central nervous system more time to grow amongst individuals whose forebears have suffered, for repeated generations, from undernourishment,

49. Nevertheless, while the research programme might ultimately have the general aim described in paragraph 47 above, it would seem obvious that the many problems involved will need to be studied not all at the same time, but in stages, for final establishment of certain scientific facts will doubtless precede others.

50. It is therefore here tentatively proposed - as a mere basis for discussion - that the research programme might comprise three main stages, as follows:

51. PHASE I - rather pragmatically - might comprise :

(a) drawing preliminary conclusions from the limited scientific research work undertaken in various countries, these last few years, in connexion with this subject;

(b) establishing a methodology for further, conclusive study;

(c) carrying out a world-wide research programme under optimal conditions (resources so far expended on this issue have been very small indeed).

52. A starting point for task (a) above might be the bringing together of as much information as is available in the world today on the degree of malnutrition amongst children 5 years of age or less. One possibility would be to measure the degree of malnutrition using the malnutrition-degree coefficients designed by Gomez et al (cf. footnote 1/ of page 3 of the present paper) and which are as follows:

53. First degree : body weight between 85 and 75 per cent of the average theoretic weight, for the age, of a well-fed child.

54. Second degree : body weight between 75 and 60 per cent.

55. Third degree : body weight less than 60 per cent.

56. Though these criteria were devised by Gomez et al as of the time of Advances in Pediatrics (1955) (cf. footnote 1/ on page 3), his description of the effects of malnutrition, as of that date, can hardly be improved upon today:

" The adult's defense against dietary deficiency is manifested by inactivity, indifference to the environment, depression and apathy; children exhibit retarded development, weight loss, physical incapacity, emotional disturbances, and at times mental defects... The children show the same symptoms of chronic starvation as their parents: indifference, gloominess, apathy, fatigue, lassitude.

" If the primary characteristic of the normal child may be defined as the uninterrupted process of growth and development, that of the undernourished child is the arrest of this process - not only of growth in height, but of mental and skeletal development as well.

" Onset of first degree malnutrition is insidious, and is generally not perceived by an unobservant mother or physician. There is no appreciable wasting, a decrease in the normal rate of weight gain for his age being almost the only sign. The slight manifestations of malaise, restlessness, an apparent intolerance for certain foods, muscular flaccidity, and a generally poor appearance receive little attention from parents whose economic level is low. The first signs subsequently disappear and the child apparently adapts himself to an inadequate food supply. But even at this stage, the most important characteristic of malnutrition - an increase in extracellular fluid - is already present.

" In the absence of improved nutrition, or with the appearance of a secondary cause of malnutrition, weight loss continues and second degree malnutrition becomes established. In this intermediate stage some patients may manifest only an accentuation of the previous vague symptoms while others, particularly pre-school children, may present a clinical picture indistinguishable from that of third degree malnutrition. ...

" All descriptions of third degree malnutrition stress the presence of mental disturbances. Curiously, both marked apathy and marked irritability are found concurrently. Somnolence and indifference, occasionally interrupted by monotonous crying or by echolalia especially in older children, are other features. Behaviour disturbances take a number of other forms: stereotypy, laceration of the skin or scalp, tearing and eating of clothing, and even coprophagy. A child with third degree malnutrition does not smile... "

57. As millions of children have suffered from malnutrition every year over so many years, it is surprising indeed that world conscience has taken so long to awaken to the issue. It is even more surprising that closer links have not been established, in the world's scientific mind, between aspects such as the effects of malnutrition on population growth because, in our opinion, the notion that better fed people will produce more children, is not necessarily true. For one thing, healthier people, not permanently on the verge of physical exhaustion, which to them means starvation or death, might be less prone to look upon children as a necessary extension of their capacity to labour. Also, only healthier farmers will be able to introduce the better technology which is imperative to survival of a large segment of the world's future population, even if the population growth rate is stemmed. Finally, perhaps human beings who live in an hostile and precarious environment fight against oblivion simply by having children, as many of them as possible, who are in fact a living protest of their right to remain on earth. All of these points are interesting, but they cannot be studied properly without a minimum of serious, statistically based scientific research.

58. To our knowledge, one of the first surveys which shows in concrete terms exactly what the situation is in this field, in a given geographical region, are surveys carried out by the Instituto de Nutrición de Centroamérica y Panamá (INCAP, Guatemala) 1/ which indicate that the human body is very hardy indeed, for

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1/ Established by the Central American governments, the INCAP is administered by the Oficina Sanitaria Panamericana, which is the executing agency for the World Health Organization in Latin America. The INCAP has benefited from assistance from UNICEF and private foundations, for research studies.

about 35% of children taken in by these surveys were found to have suffered from malnutrition to the First Degree (cf. para 54 above); 30% to the Second Degree; and about 3% to the Third Degree (e.g. those who, in this group, had not died or had not died as yet). The results of these INCAP surveys are summarized in Table 5 below, and compared with population figures. Table 5 should in turn be kept in mind when looking at:

Table 6: Population by age groups 1960 and 1965-1968,

Table 7: Total enrolment by level of education - 1960, and 1965-1968,

Tables 8, 9 and 10: Internal efficiency of primary education systems,

and, returning to the situation in Central America taken as base, with:

Tables 11, 12, 13, 14 and 15, which respectively show the flow of

59. primary-school pupils in Costa Rica, El Salvador, Guatemala and Panama, respectively, with indications as to Urban/Rural and Dropout/Repetition rates. Finally, Table 5 might be compared with:

60. Table 16, which contains primary-school flow diagrams for Brazil as a whole and for three main sub-regions of Brazil, and can be used as a point of comparison with the Central American figures.

Table 5. Malnutrition amongst children less than 5 years of age in Central America and Panama

	Total (national) population 1, 2, 3 and 4 years of age	First degree malnutrition weight 85 to 75 % of average theoretical weight for the age	Second degree: weight 75 to 60 % of average theoretical weight for the age	Third degree: weight less than 60 % of average theoretical weight for the age	First degree malnutrition	Second degree malnutrition	Third degree malnutrition	Total % malnourished amongst children 0-4
Unit	000's	000's	000's	000's	% of pop. 0-4	% of pop. 0-4	% of pop. 0-4	
Sources	(1)	(2)	(2)	(2)	(3)	(3)	(3)	
Costa Rica (1966)	1.541 / 298.9	120	38	5.1	40.1	12.7	1.7	54,5
El Salvador (1966)	3.037 / 582.9	268	127	17	46	21.8	2.9	70,7
Honduras (1966)	2.256 / 450.2	149	94	8	33.1	20,9	1.8	55,8
Guatemala (1965)	4.438 / 845.0	408	220	49	48.3	26.0	5.8	80,1
Nicaragua (1966)	1.720 / 339.8	120	37	5	35.3	10,9	.1,5	47,7
Panama (1967)	1.329 / 236.3	101	22	2.3	42.7	9.3	1,0	53,0

Sources : (1) UN population statistics

(2) INCAP: Evaluación Nutricional de la Población de Centro América y Panamá, 1969

(3) Calculated by Office of Statistics, Unesco.

Table 6 . Population by age group 1960 and 1965 - 1968 (in thousands)

Major regions \ Age-group		TOTAL	0 - 4	5 - 9	10 - 14	15 - 19	20 - 24
WORLD TOTAL	1960	2 981 621	429 002	368 418	317 578	269 301	252 248
	1965	3 289 002	456 944	407 593	363 347	313 399	264 106
	1966	3 355 108	466 631	412 788	370 691	321 851	272 213
	1967	3 422 741	476 651	418 143	378 195	330 580	280 601
	1968	3 491 938	487 015	423 662	385 870	339 590	289 281
AFRICA	1960	269 577	47 259	37 381	31 817	27 510	23 786
	1965	303 148	53 726	42 256	35 901	30 931	26 600
	1966	310 998	55 177	43 456	36 828	31 702	27 240
	1967	319 051	56 667	44 690	37 779	32 494	27 896
	1968	327 312	58 197	45 958	38 755	33 306	28 569
NORTHERN AMERICA	1960	198 675	22 611	20 861	18 661	14 856	12 346
	1965	214 329	22 706	22 786	21 006	18 826	15 060
	1966	216 915	22 328	22 805	21 384	19 272	15 789
	1967	219 531	21 956	22 824	21 768	19 729	16 554
	1968	222 179	21 590	22 843	22 159	20 196	17 357
LATIN AMERICA	1960	213 422	35 692	29 703	24 907	20 946	17 933
	1965	245 884	40 644	34 492	29 372	24 528	20 587
	1966	252 941	41 741	35 420	30 277	25 382	21 258
	1967	260 200	42 867	36 373	31 210	26 265	21 950
	1968	267 668	44 024	37 351	32 172	27 178	22 665
ASIA	1960	1 645 390	259 352	219 646	186 811	160 845	143 768
	1965	1 832 923	275 529	244 181	216 078	183 705	156 735
	1966	1 875 377	283 434	247 239	220 675	189 061	160 092
	1967	1 918 864	291 582	250 395	225 371	194 597	165 367
	1968	1 963 407	299 981	253 653	230 169	200 321	169 861
EUROPE & USSR	1960	638 801	62 176	59 122	53 805	43 880	53 325
	1965	675 198	62 269	61 951	59 242	53 797	43 816
	1966	681 002	61 865	61 906	59 736	54 789	45 563
	1967	686 857	61 477	61 863	60 233	55 816	47 398
	1968	692 764	61 104	61 823	60 736	56 876	49 324
OCEANIA	1960	15 756	1 912	1 705	1 577	1 264	1 090
	1965	17 520	2 070	1 927	1 748	1 612	1 308
	1966	17 875	2 086	1 962	1 791	1 645	1 371
	1967	18 238	2 102	1 998	1 834	1 679	1 436
	1968	18 608	2 119	2 034	1 879	1 713	1 505
(ARAB STATES)	1960	(93 566)	(16 466)	(13 216)	(11 219)	(9 572)	(8 171)
	1965	(107 045)	(19 402)	(15 321)	(12 879)	(10 943)	(9 257)
	1966	(110 350)	(20 036)	(15 838)	(13 287)	(11 275)	(9 543)
	1967	(113 758)	(20 689)	(16 374)	(13 707)	(11 616)	(9 837)
	1968	(117 271)	(21 365)	(16 929)	(14 140)	(11 967)	(10 142)

Source: UN statistics.

Table 7 . Total enrolment by level of education - 1960, and 1965 - 1968.

Major regions		Number of pupils enrolled (in thousands)							
		TOTAL	% increase	First level	% increase	Second level (general, vocational and teacher training)	% increase	Third level	% increase
WORLD TOTAL [1]	1960	323 587	-	243 487	-	68 926	-	11 174	-
	1965	411 132	4.9	299 337	4.2	93 788	6.4	18 007	10.0
	1966	428 405	4.2	311 700	4.1	96 713	3.1	19 992	11.0
	1967	443 619	3.6	320 814	2.9	101 268	4.7	21 538	7.7
	1968	459 599	3.6	330 832	3.1	105 651	4.3	23 115	7.3
AFRICA	1960	21 238	-	18 931	-	2 115	-	192	-
	1965	29 861	7.1	25 924	6.5	3 615	11.3	322	10.9
	1966	30 975	3.7	26 748	3.2	3 893	7.7	334	3.7
	1967	32 758	5.8	28 028	4.8	4 373	12.3	358	7.2
	1968	34 421	5.1	29 322	4.6	4 715	7.8	383	7.0
NORTHERN AMERICA	1960	48 719	-	28 838	-	16 156	-	3 725	-
	1965	57 370	3.3	32 855	2.6	18 665	2.9	5 850	9.4
	1966	59 187	3.2	33 606	2.3	18 855	1.0	6 726	15.0
	1967	60 269	1.8	33 360	-0.7	19 547	3.7	7 362	9.5
	1968	61 866	2.6	33 201	-0.5	20 674	5.8	7 991	8.5
LATIN AMERICA	1960	31 425	-	26 973	-	3 885	-	567	-
	1965	42 290	6.1	34 704	5.1	6 694	11.5	892	9.5
	1966	45 099	6.6	36 653	5.6	7 468	11.6	978	9.6
	1967	47 758	5.9	38 288	4.5	8 365	12.0	1 105	13.0
	1968	50 851	6.5	40 751	6.4	8 847	5.8	1 253	13.4
ASIA [1]	1960	110 691	-	87 236	-	21 325	-	2 131	-
	1965	148 301	6.0	113 876	5.5	30 703	7.6	3 722	11.8
	1966	157 802	6.4	121 516	6.7	32 105	4.6	4 181	12.3
	1967	164 194	4.1	126 880	4.4	32 724	1.9	4 590	9.8
	1968	171 437	4.4	132 567	4.5	33 962	3.8	4 908	6.9
EUROPE & USSR	1960	108 208	-	79 106	-	24 644	-	4 457	-
	1965	129 343	3.6	89 329	2.5	32 983	6.0	7 031	9.6
	1966	131 237	1.5	90 458	1.3	33 214	0.7	7 565	7.6
	1967	134 400	2.4	91 475	1.1	35 018	5.4	7 907	4.5
	1968	136 615	1.6	92 142	0.7	36 112	3.1	8 361	5.7
OCEANIA	1960	3 306	-	2 403	-	801	-	102	-
	1965	3 967	3.7	2 649	2.0	1 128	7.1	190	13.2
	1966	4 105	3.5	2 719	2.6	1 178	4.4	208	9.5
	1967	4 240	3.3	2 783	2.4	1 241	5.3	216	3.8
	1968	4 409	4.0	2 849	2.4	1 341	8.1	219	1.4
(ARAB STATES)	1960	(8 595)	(-)	(7 177)	(-)	(1 248)	(-)	(160)	(-)
	1965	(12 613)	(8.0)	(10 034)	(6.9)	(2 290)	(12.9)	(288)	(12.6)
	1966	(13 122)	(4.0)	(10 300)	(2.7)	(2 527)	(10.3)	(295)	(2.1)
	1967	(13 748)	(4.8)	(10 708)	(4.0)	(2 734)	(8.2)	(306)	(3.7)
	1968	(14 396)	(4.7)	(11 016)	(2.9)	(3 041)	(11.2)	(339)	(10.8)

1) Not including China (mainland), Democratic People's Republic of Korea and Democratic Republic of Viet-Nam.

Compiled by: Office of Statistics, Unesco.

Tables 8, 9 and 10: Internal efficiency of primary education systems

1. The 1969 survey of educational wastage by the Office of Statistics of Unesco allowed a depth analysis of the educational systems of 35 countries. The coverage was limited for that survey to the first and general second levels of education, for the years 1960/61 to 1967/68. It might be interesting to give an idea of the relative importance of the coverage, by regions, as follows:

Table 8.

Major Regions	Number of countries covered	% of school population at the 1st level in those countries, compared with total in the Continent (1965)
Africa	18	36.7
Latin America	13	77.9
Asia	13	71.0
Europe	11	45.7

2. Two major results appeared from the study:

(1) There are two quite distinct features of wastage - namely repetition and drop-out - and they sometimes work in very different directions. Separate profiles for both factors are thus essential for a meaningful system analysis as well as for the evaluation of the cost of wastage - evaluated in the study in non-monetary terms.

(2) Wastage indicators have a concrete meaning when considered within the context of each educational system and, therefore, any comparisons or generalization could lead to misunderstanding.

3. For the purpose of the survey, "Educational Wastage" was defined as:
"Incidence in a country's educational system, from the point of view of its efficiency, of factors such as premature school leaving and retardation or repetition". Drop-outs are statistically counted as a waste, even if, after several grades, the pupil who drops-out without concluding the cycle did in fact gain a basic knowledge that raised his level of educational attainment. The level of attainment is linked to the concept of stock while the measurement of wastage must be directed towards the dynamics of school populations, i.e. towards their flows. Similarly, repetition is a waste because repeaters reduce the intake capacity of the grade where they repeat, thus preventing other children from entering school (or cause crowding of classrooms) and consequently increasing the costs of education.

4. The cost of wastage, in non-monetary terms is estimated per successful completer through the relationship "Pupil-years invested/Normal duration", called "Input/output ratio". In a system working under optimum conditions, this ratio should be 1.00 and, thus, the difference between the derived ratio and this optimum is the excess in "cost".

5. First Level

Input/output ratios

Table 9.

Countries in Major Regions	Range of input/output ratios	Median input/output ratios
Africa	1.24-3.55	2.00
Latin America	1.53-2.42	1.90
Asia	1.00-2.48	1.31
Europe	1.00-1.56	1.20

The above ratios show that, for instance in Africa, the median "cost" to the system per successful completer was double the prescribed one. In other words, only half of the cost was effective since repetition and drop-out were responsible for the other half. For a full view of the internal efficiency of the educational system, it is necessary to combine these ratios with the estimated output from the system or, their complement, the overall drop-out, as shown below:

Estimated per cent drop-out in cohorts entering school around 1960

Table 10.

Countries in Major Regions	Range of drop-out	Median drop-out
Africa	26.2 - 81.3	54.0
Latin America	33.1 - 74.7	61.6
Asia	0.7 - 64.0	20.2
Europe	0.7 - 48.3	18.3

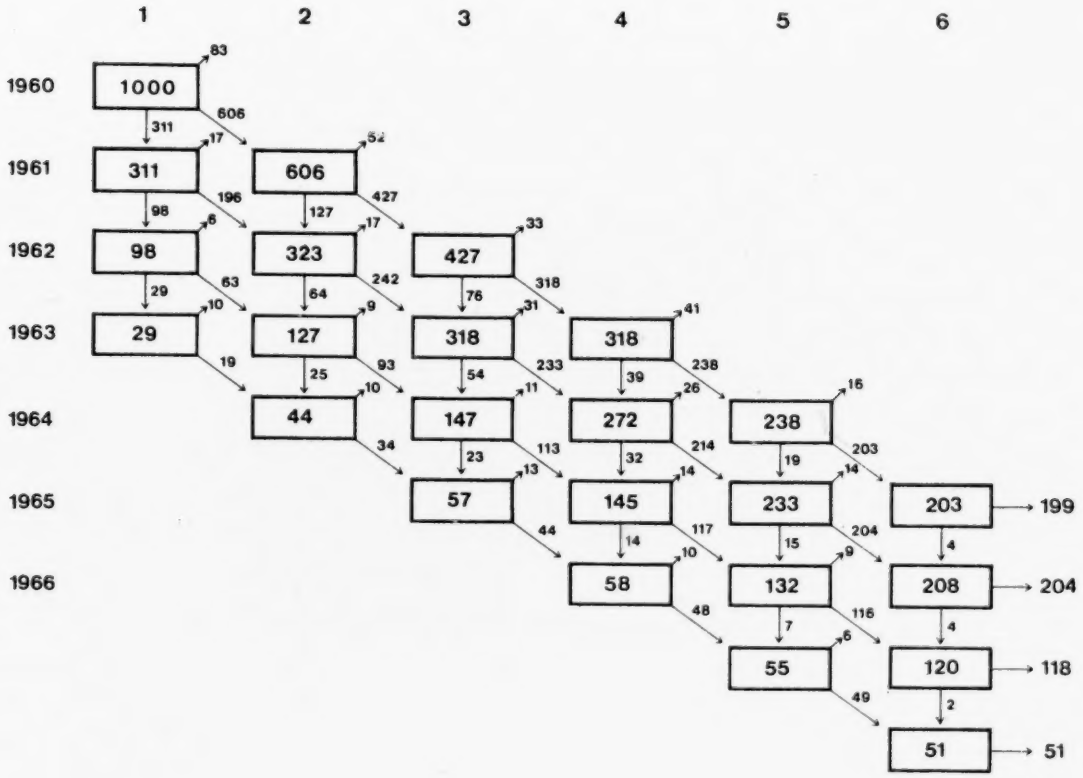
6. Due to the complexity of "wastage", any generalization could be misleading. The above tables show the wide range for each indicator (somewhat distorted in the case of Asia, where 4 countries studied have systems of automatic promotion), which give some idea of the problem at the regional level.

7. The indicators derived as stated in the survey, can be properly interpreted only if related factors are considered, such as: actual capacity of the school systems (which in some cases do not allow enough promotion), overall intake etc. As the ratios are expressed in percentage terms, their meanings are naturally not the same for countries with a very high enrolment ratio as it is for those with a low one, where both "cost" and drop-out should be lower.

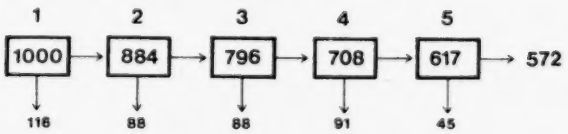
Prepared by: Office of Statistics, Unesco.

TABLE 11

COSTA RICA - Flow Diagram: Primary Education, Urban & Rural



Evolution de la cohorte - GF

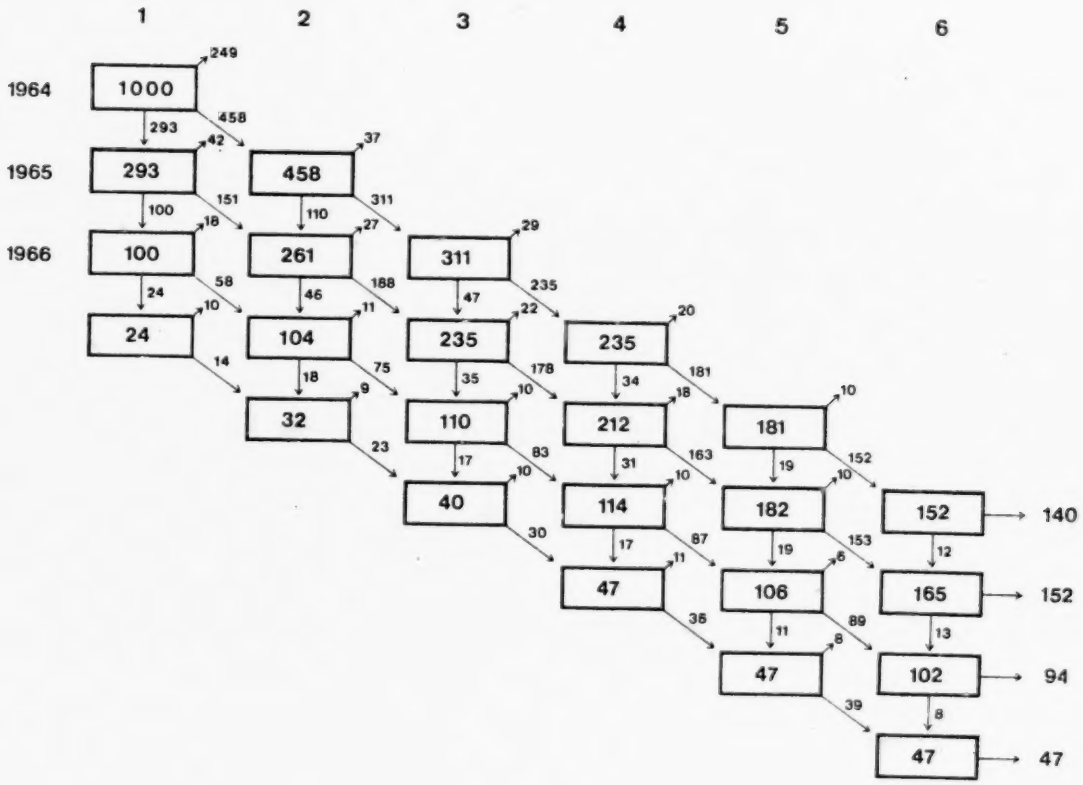


Durée en années			
Année d'étude	GF	G	F
1	1 438		
2	1 100		
3	949		
4	793		
5	658		
6	582		
Total	5 520		
Sortants	572		
Elève /Années	9.65		
Input/Output	1.61		

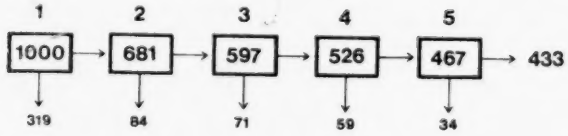
Source: Office of Statistics, Unesco

TABLE 12

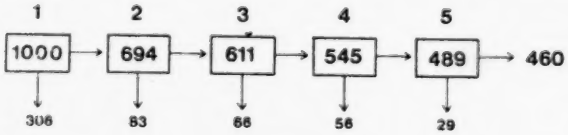
EL SALVADOR - Flow Diagram: Primary education, urban & rural, boys & girls



Evolution de la cohorte - GF



Garçons



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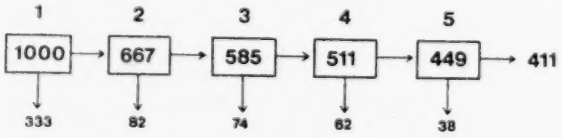
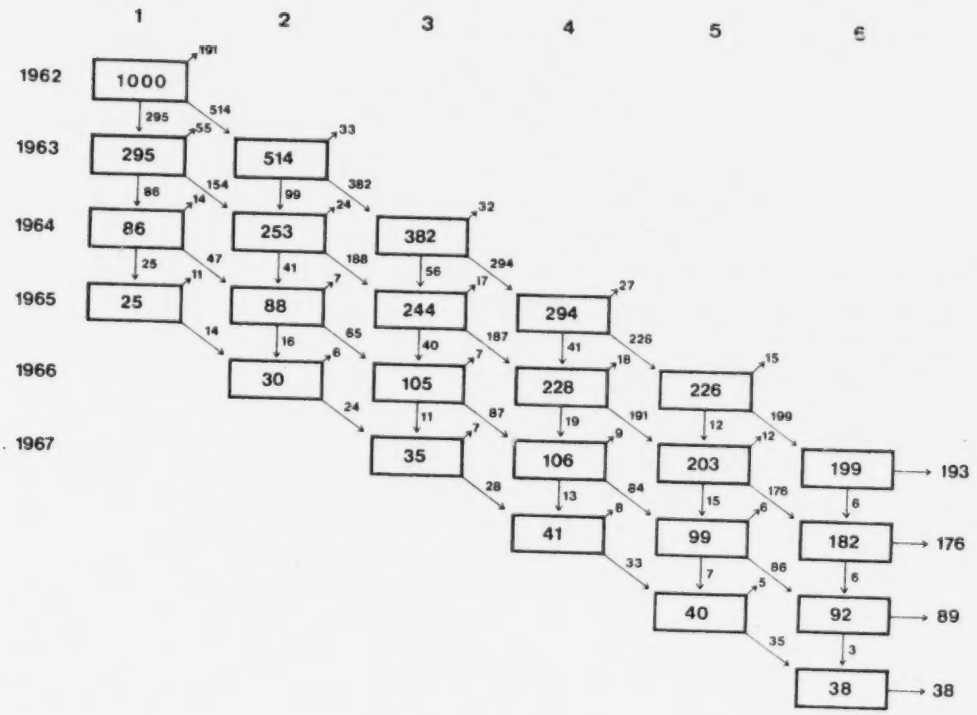


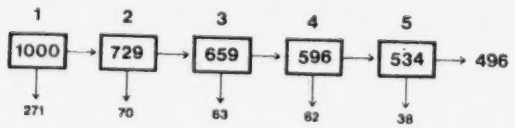
Durée en années			
Année d'étude	GF	G	F
1	1 417	1 438	1 395
2	855	874	838
3	696	711	683
4	608	631	591
5	516	541	498
6	466	496	441
Total	4 558	4 691	4 446
Sortants	433	460	411
Elève /Années	10.52	10.20	10.86
Input/Output	1.75	1.70	1.81

Source: Office of Statistics, Unesco

Table 13. Flow Diagram: Primary Education: Guatemala: Urban girls and boys



Evolution de la cohorte - GF



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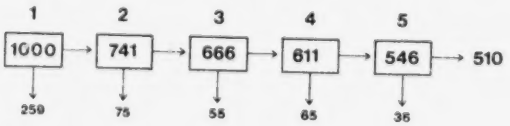

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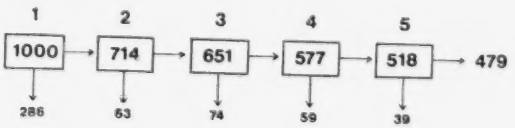
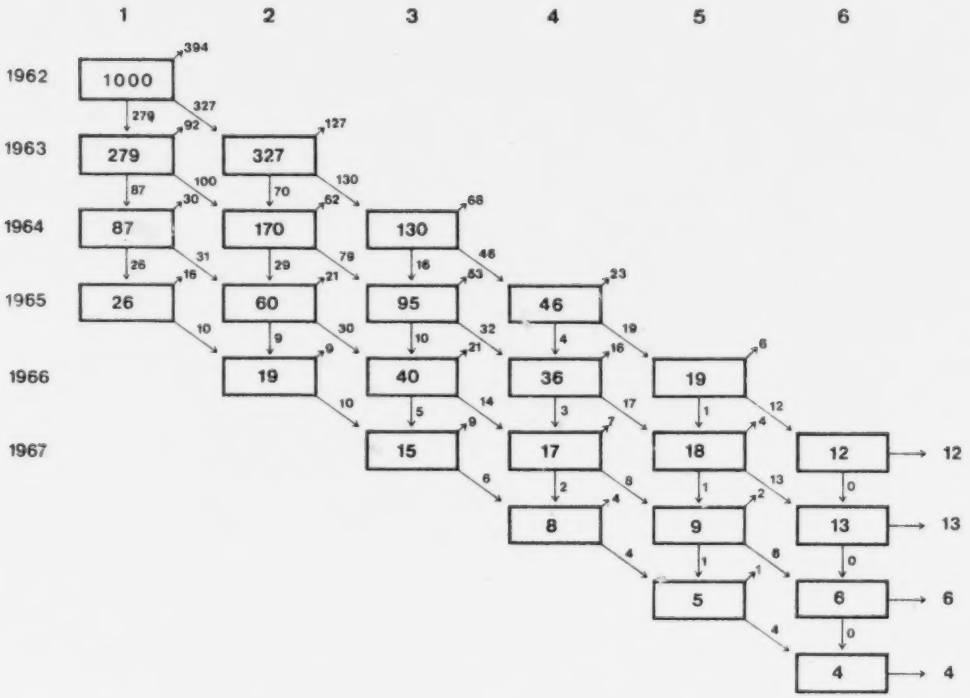


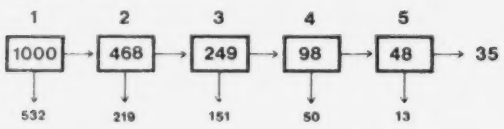
Durée en années			
Année d'étude	GF	G	F
1	1 406	1 416	1 394
2	885	901	868
3	766	775	754
4	669	686	647
5	568	583	551
6	511	525	489
Total	4 805	4 986	4 703
Sortants	496	510	479
Elève /Années	9.69	9.58	9.82
Input/Output	1.61	1.60	1.64

Source: Office of Statistics, Unesco

Table 14. Flow Diagram: Primary Education: Guatemala : Rural girls & boys



Evolution de la cohorte - GF



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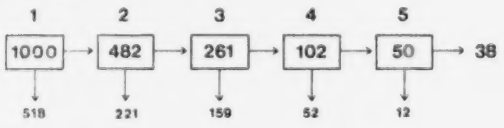

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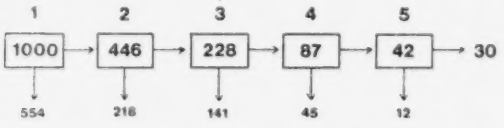
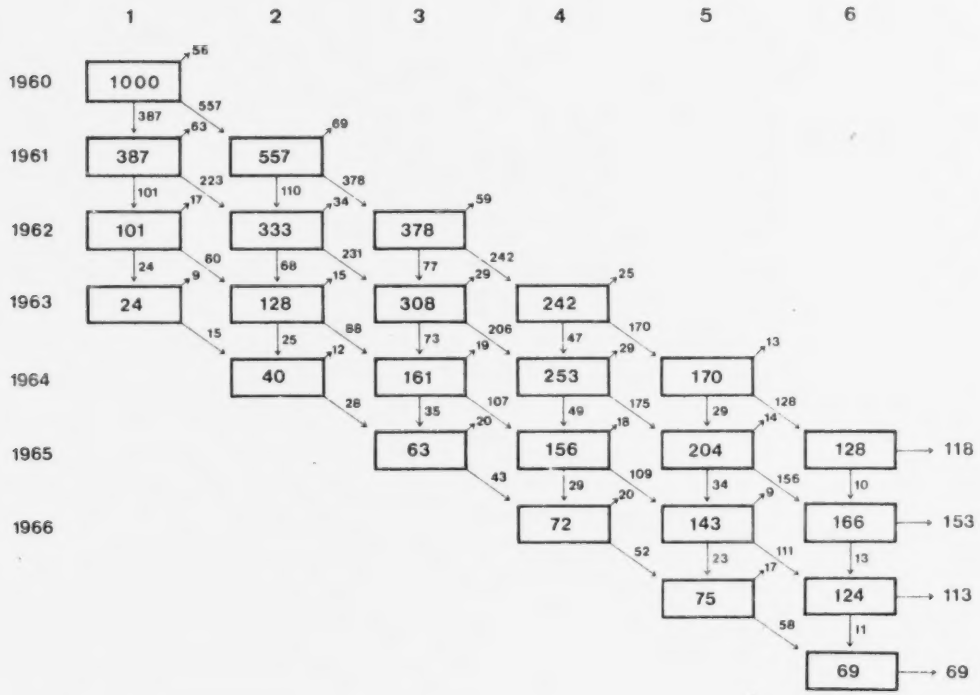


Durée en années			
Année d'étude	GF	G	F
1	1 392	1 398	1 379
2	576	597	545
3	280	296	256
4	107	111	96
5	51	53	44
6	35	39	30
Total	2 441	2 494	2 350
Sortants	35	38	30
Elèves/Années	69.74	65.63	78.33
Input/Output	11.62	10.93	13.06

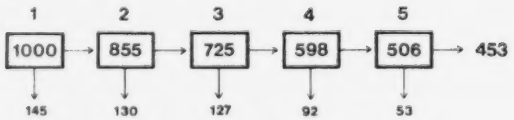
Source: Office of Statistics, Unesco.

TABLE 15

PANAMA - Flow diagram: Primary education, rural boys and girls



Evolution de la cohorte - GF



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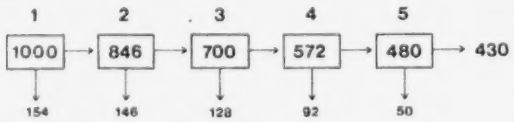
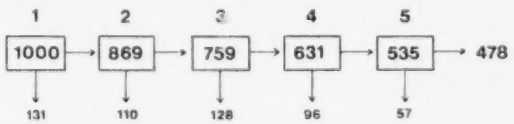


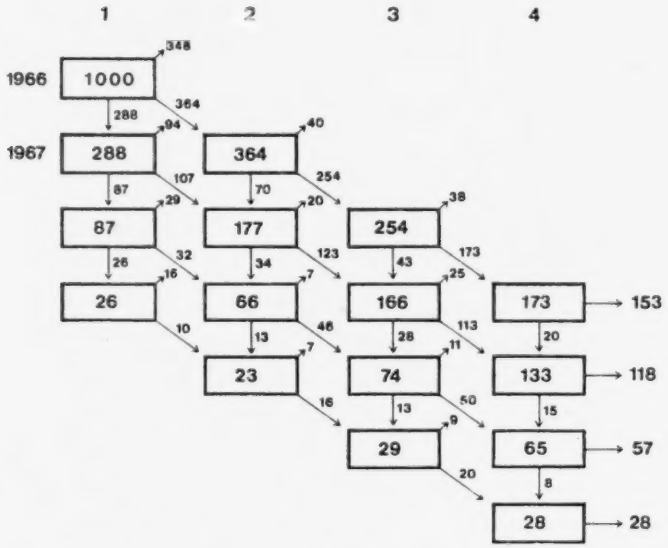
Filles



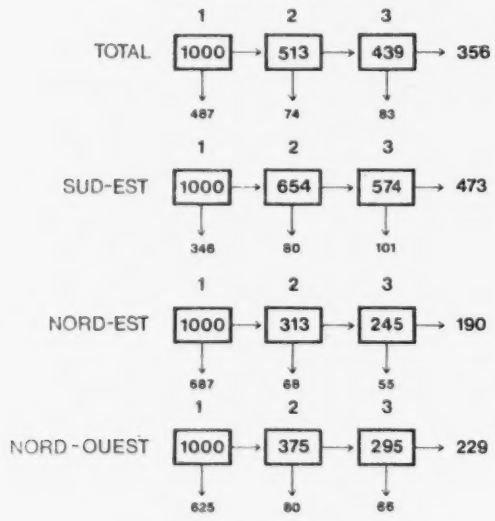
Durée en années			
Année d'étude	GF	G	F
1	1 512	1 545	1 477
2	1 058	1 059	1 064
3	910	898	929
4	723	706	746
5	592	573	612
6	487	464	511
Total	5 282	5 245	5 339
Sortants	453	430	478
Elève /Années	11.66	12.20	11.17
Input/Output	1.94	2.03	1.86

Source: Office of Statistics, Unesco

TABLE 16 BRESIL - Flow diagram: Primary education, Urban & rural, boys & girls



Evolution de la cohorte - GF



Durée en années				
Année d'étude	TOTAL	S-E	N-E	N-O
1	1 401	1 493	1 283	1 268
2	630	815	365	438
3	523	691	280	337
4	399	531	211	254
Total	2 953	3 530	2 139	2 297
Sortants	356	473	190	229
Elève /Années	8.29	7.46	11.26	10.03
Input/Output	2.07	1.87	2.81	2.51

Source: Office of Statistics, Unesco

61. Assuming that the data contained in the above tables is sufficiently suggestive to urge further comparative study, it would still remain to evaluate the few studies which have been carried out with a view to measuring the extent of mental retardation induced by malnutrition, if only as a means of developing the improved methodology mentioned in parapraph 51 (b) of the present paper. These specific studies include the following:

62. In 1965, Cabak and Najdanvic presented evidence showing that Yugoslav children who had been seriously undernourished in infancy were found at school-age to have normal physical characteristics but subnormal mental capacity (cf. Graph on page 12 of the present paper) 1/

In 1967, Liang, Hie, Jan and Giok studied a group of Indonesian children aged 5-12 years whose early nutritional history and nutritional status 6 years prior to the study were known. On the basis of the intelligence quotient, using the test procedures of Wechsler and Goodenough, it was found that the children's intellectual development, as well as their physical development, could be predicted with a high degree of accuracy on the basis of their nutritional status during the pre-school years. The lowest values were found in children that had been malnourished and had shown clinical signs of vitamin A deficiency during the 2 to 4-year age period and the highest in those who had never been diagnosed as malnourished. 2/

In 1968, Champakam, Srikantia and Gopalan studied nineteen Indian children successfully treated for kwashiorkor to see the effect of early malnutrition on growth and mental functions. A significant difference was found between the performance of the control and the experimental subjects with regard to the intelligence tests . Intersensory organization was poorer in the experimental subjects than in the control subjects. The retardation was noticeable mainly with regard to perceptual and abstract abilities. 3/

In 1970, Cravioto and Delicardie, on the basis of a series of studies on malnourished Mexican children, reached the conclusion that children who survive a severe episode of malnutrition early in life are handicapped in developing skill in reading and writing and are less able to profit from the cumulative knowledge available to the human species in general, and to their socio-economic group in particular. 4/

1/ Cabak, V. and Najdanvic, R. 1965. Effect of undernutrition in early life on physical and mental development. Arch. Dis. Childh. 40: 532-534.

2/ Liang, P.H., Hie, T.T., Jan, O.H. and Giok, L.T. 1967. Evaluation of mental development in relation to early malnutrition. Am. J. Cl. Nutr. 20: 12: 1290-1294.

3/ Champakam, S., Srikantia, S.G. and Gopalan, C . 1968. Kwashiorkor and mental development. Am. J. Cl. Nutr. 20: 8: 844-852.

4/ Cravioto, J. and Delicardie, E.R. 1970. Mental performance in school age children: Findings after recovery from severe malnutrition. Am. J. Dis. Child. 120: 404-410.

The common methodological feature of the above four studies is that they involved the study of children. Doubtless other studies, not well known or not published, which have also been based on the measurement of children's physical and mental development, exist (we understand, for instance, that this is the case of several studies made by Ministries of Health of European war-devastated nations, which were concerned with the effects of severe malnutrition or even starvation amongst clearly identified groups of children in zones affected by World War II). All of this material should be brought together and sifted; and it should be compared with work on experimental animals.

69. Yet there already is world-wide recognition - intuitive if not always scientific - that the implications of malnutrition amongst very young infants are indeed frightening. As of 1965 Scrimshaw and Béhar (the first being a former Director of INCAP and the latter the present Director of INCAP) affirmed that:

"Malnutrition in the early life of experimental animals has a direct effect on subsequent function of the central nervous system. This is true for both protein malnutrition and severe underfeeding, and also for some vitamin deficiencies. Predictably the effect varies with the kind and severity of deficiency, the species studied, and the tests employed. The best evidence comes from work with rats, dogs, pigs, and hamsters. As expected, deficiencies induced in the experimental animal soon after birth have more of an effect on learning and behavior than those initiated at the end of normal lactation.

The fetus is much less vulnerable to the effects of malnutrition than the newborn because of its ability to gain nourishment at the expense of the mother. Intra-uterine malnutrition can result from placental abnormalities but rarely from maternal dietary restriction. Thus, malnutrition of the mother during pregnancy has little or no effect on the birth weight of the young or on their subsequent growth and development if nursed by a well-fed foster mother. If the deficiency continues during lactation, however, prior nutritional deficiency of the mother during pregnancy may have a profound effect on subsequent events. This is mainly because the offspring of nutritionally deficient mothers are born with smaller stores of a number of important nutrients and are therefore more readily and seriously affected by dietary deficiencies after birth.

The milk of nutritionally deficient mothers is affected both quantitatively and qualitatively, and breast feeding under such circumstances fails to compensate fully for the poor stores. Thus, even if maternal malnutrition has produced no irreversible damage to the fetus, it can still exert a significant postnatal influence in experimental animals and in human populations . Moreover, a mother malnourished during pregnancy does not herself become well nourished immediately upon being given a good diet after parturition. In such cases, a carry-over effect is observed; the young grow and develop less well than those of mothers well nourished throughout pregnancy and lactation. Maternal malnutrition must, therefore, be taken into account in the design of clinical research even when the primary objective is the study of postnatal malnutrition." 1/

1/ Scrimshaw, N.S. and Béhar, M. 1965. Malnutrition in underdeveloped countries. New Engl. J. Med. 272: 137-144, 193-198. Dr. Scrimshaw has, for for many years, been President of the United Nations Protein Advisory Group (PAG).

64. As might be surmised, the trend for world-wide recognition could hardly fail to lead to multidisciplinary efforts, and it is in this connexion that Unesco's first involvement in the issue arose, on the occasion of the Symposium on Brain Research and Human Behavious held at Unesco House on 11-15 March 1968. The Symposium's Round Table IV, on "The influence of nutrition and environment on brain functions", chaired by Dr. C. A. Canosa of the INCAP, Guatemala, concluded the following:

> "A general consensus was reached on the close and direct influence of nutrition on brain development, particularly in its critical early periods, during which the brain attains a maximal rate of growth and the whole further development of the animal is determined. Malnutrition during these periods results in retardation of growth, in loss of the mental potential existing in early age and in a a decreased ability to solve complex problems.
>
> Parallel to the dietary requirements, there exists the need of an adequate external environment for the full achievement of mental potentialities. "Sociological malnutrition" during developmental periods leads also to poor mental performance and to behavioural disturbances later in life ."[1/]

65. Those who are interested more specifically in educational matters could thus, in turn, hardly fail to question themselves as to the educational implications of malnutrition. Curiously enough, while the "exact" scientists have gone out of their way to try to look into these matters, surprisingly little has been done with a like aim by the social scientists. Yet, to the extent that the social scientists can, do or must rely on the judgement of highly trained observers, they should be able to confirm the general thesis indicated above, at least -- and, later -- to pinpoint the various implications, not the least in the field of education itself, affected in many ways.

66. Failing any large-scale study on this matter which might have been undertaken without our knowledge, reference can at least be made, for the moment, to a research study - the limitations of which we are all too aware -- which was undertaken by the author of the present paper during the three-year period du ing which he served as Unesco Chief of Mission in Central America and Panama. This study was triggered by advance news of the extremely distressing results of the INCAP

1/ Final Report of the Unesco Symposium on Brain Research and Human Behaviour: Unesco, Paris, 11-15 March 1968. Unesco document SC/MD/7 (1968), page 5.

survey, to which reference is made in para. 56. It consisted of the following: during trips to several countries of the area, about 50 primary schools in isolated rural areas (often very visible from the road as one drives past) were visited without prior announcement, for the explained purpose of donating posters and information about Unesco, to the school.

67. These donations were always extremely well received, enabling a friendly talk to be engaged with the teacher, in which she (sometimes he) was asked to call over her brightest pupils. We were on those occasions able to ascertain that these usually looked fairly healthy. After having talked to the brightest pupils a little, the question was asked: Do you have "problemas de educación especial", or, in other words: "Is assistance required by some of the pupils in your class of a special type extending beyond the instruction you yourself can give and are equipped for ?" The answer usually was : "If you knew!" And it would become apparent, from what the teacher said, that she considered that a sizeable number of children in her class were indeed in need of special education (though she knew there was no hope that it would become available). Most teachers added that these pupils would doubtless drop out of school "in the second semester or next year", or repeat class (some had done so for 3 years running).

68. The teacher was then asked to call over some of the children in this category, and it was obvious (even to someone with limited medical training) that the overwhelming proportion of them had suffered severely from malnutrition and were sub-standard in size. Far from us to suggest that this random and somewhat subjective survey is conclusive and, to use an "The significance, if any, of these findings is pure speculation". But the reader should know that the conviction of the importance of the child malnutrition problem that we gathered from this survey (now three years old) remains so vivid that it is the sole force behind the writing of the present paper.

69. The question is: Where does Science go from here, in connexion with this issue ?

70. The studies carried out by Dr. Cravioto, the INCAP and the University of Manchester suggest, in our opinion, that more research is needed, at an international scale and according to a methodology worked out in advance and accepted by all concerned, to evaluate the factors which lend themselves more easily to evaluation. These factors might include simple comparative anthropometric measurement and comparison of the ill-nourished and well-nourished, within a given specific group (using the well-nourished in the group as a "standard" 1/) together with chemical analysis of various types and other possible means of "physical" evaluation, under comparable environmental conditions.

1/ There would, in our opinion, be little point in measuring Swedish tots, for instance, against Vietnamese tots, because their average sizes are not similar.

71. Perhaps it would be possible, as the end result for these studies, to establish, for as large as possible a number of countries, comparable "minimization indices of child growth" corresponding to 3 degrees of malnutrition such as those indicated in para. 54. From that moment on, pedagogues and educational planners, amongst others, would possess a powerful new tool to help them in their work. For instance, educational plans and programmes for countries with very high indices of "child minimization" would not be conceived in the same way as those where malnutrition amongst children is very low.

72. At not very great cost, it should moreover be possible to establish rank and multiple correlations between data on: (a) "minimization indices of child growth"; (b) income level; (c) place of residence (urban/rural); (d) extent to which women's education is available and includes the teaching of nutrition; (e) general protein availability; (f) extent to which medical services are easily within reach of expectant mothers and infants; (g) availability of general adult education; and other related factors.

73. PHASE II - The influence of environmental factors on education is so strong, however, that in our opinion this should be the subject of special study, which might constitute Phase II of the research programme.

74. Phase II would be initiated, as might seem feasible and possible, either concurrently with Phase I, or subsequently. Its objective would be to seek answers to the following type of question:

75. - Assuming that a child has not suffered from malnutrition, to what extent is environment (in the widest sense of the term) accountable for what he learns and in what ways? How does this compare with the situation for undernourished children ?

76. - In particular, does unfavourable or hostile environment [1] for repeated generations, lead to functional adaptation of neuro-psychological attitudes to a sub-optimal level?

77. Should the answer to the preceding question be affirmative:
- Can re-adaptation to the optimal level be achieved within a single generation, or does re-adaptation require a slow, multi-generation process? What is the role of improved food in this re-adaptation?

78. Aware as we are, of the huge challenge posed by these questions, we do not at the same time believe them to be beyond the reach of present scientific capability. In any event, efforts to carry out the required research should be made. Humanity needs to evaluate what the cumulative effects of economic and social disadvantage are, in connexion with performance of the human body and neural system.

1/ For instance, abnormal conditions such as those created by war, slavery or trade isolation, which might have long-lasting nutritional effects.

79. The problems posed by planning of research in Phase II are so complex that they would doubtless need particularly careful study before an international research programme - likely to be long and costly - could usefully be embarked upon. The required research clearly cannot be left to the educators alone. The combination of knowledge on genetics, health, nutrition, molecular biology, biochemistry, human communication (both inter-personal and mass), environmental physiology and environmental psychology would seem to be of salient promise.

80. PHASE III - Even then, much important research would in our opinion remain to be done in connexion with the issue. Ultimately, this is a problem which historians, statesmen, economists, sociologists and - last but not least - philosophers, should think about.

81. Who knows, perhaps what we are here touching is the very essence of what has made world history, the rise and fall of empires, and that mere fragment of history with which we are more familiar and which has split the world in two differently developed segments? Has the emergence of all great civilizations not been linked to the availability of food, or to the search for food? After all that has been written (and the even more that has been said) about underdevelopment and its causes, could it be that the food assimilation systems of unborn babies and of young tots are the shortest road to development?

III. POSSIBILITIES FOR IMMEDIATE CORRECTIVE ACTION

82. In our opinion, only a comprehensive research programme such as mentioned above would enable a well-thought out and adequately balanced programme of remedial action to be undertaken, in connexion with the issue discussed in the present paper.

83. Nevertheless, a great many elements for corrective action are already at hand, both in terms of institutional capability and of existing scientific knowledge (for instance, for the production of inexpensive, protein-rich infant foods). It would therefore seem evident that no efforts should be spared to take full advantage of immediately available operational opportunities.

84. The scientific commmunity as a whole should, in our opinion, be invited to take swift action, to the full extent of its possibilities.

85. In so far as concerted action by the United Nations family of organizations is concerned, immediate attention to the problem was called for by the United Nations Advisory Committee on the Application of Science and Technology to Development, at its twelfth session (Addis Ababa, 24 November - 5 December 1969). After consideration of a report from the FAO/WHO/UNICEF Protein Advisory Group (PAG) and progress reports submitted by

various agencies including Unesco, the Committee issued a statement insisting "on the necessity of adequate protein for pre-school children receiving the highest priority in all programmes aimed at meeting the protein crisis".

86. One measure of concrete remedial action suggested by the Committee is the establishment of a "protein promotion fund" which, it stated, is necessary in order to bring an adequate level of resources to bear on the protein problem".

87. The Committee moreover appealed to the United Nations Development Programme to study the possibility of supporting research "of broad interest to many developing countries", in relation to the protein problem, even if such research were to be undertaken by research centres outside the developing countries.

88. It is to be hoped that Unesco will be closely associated with the execution of such measures. As the present paper indicates, the Organization is directly connected with the problem because it is the focal point in the United Nations system for promoting scientific policy. Moreover, as stated, malnutrition problem seriously inhibits and minimizes educational effort.

89. Last - and perhaps most important - only parents (particularly mothers) are in a position to significantly improve child nutrition, particularly during the early stages of life.

90. The "brain growth issue" might therefore, in our opinion, ultimately be related to the problems of adult education more than to the protein shortage. Some voices have already pointed out that a fraction of the protein available to disadvantaged communities could suffice to meet the needs of expectant mothers and of very young children, provided these protein consumers were given sufficient priority over other consumers.

91. The same voices have expressed the view that even if protein should become available in plentiful and cheap supply in developing communities, there is a real danger that it might fail to reach expectant mothers and young children, because of prevalent unscientific habits of food preparation and distribution, down to the family level.

92. Among measures for corrective action, nations might therefore wish to consider an intensification of their efforts to incorporate the teaching of nutrition not only within the scope of adult education programmes, but at teacher training schools and at pre-primary, primary and secondary schools.

The required action programmes are of great magnitude, since the number of people involved - as suggested by Table 17, is huge and fast growing.

Table 17. Adult literacy around 1960 and 1970 - males and females

Major regions	Around 1960				Around 1970			
	Adult population 15 years old and over (000)	Literate adults (000)	Illiterate adults (000)	Illiteracy percentage	Adult population 15 years old and over (000)	Literate adults (000)	Illiterate adults (000)	Illiteracy percentage
MALES								
WORLD TOTAL	916 000	609 000	307 000	33.5	1 127 000	812 000	315 000	28.0
AFRICA	75 900	20 200	55 800	73.4	96 000	35 100	60 900	63.4
NORTHERN AMERICA	66 800	65 600	1 300	1.9	78 000	77 200	850	1.1
LATIN AMERICA	61 300	44 000	17 400	28.4	81 000	64 900	16 100	19.9
ASIA	494 000	270 000	224 000	45.3	624 000	393 000	231 000	37.0
EUROPE AND U.S.S.R.	213 000	205 000	7 700	3.6	243 000	237 000	5 800	2.4
OCEANIA	5 300	4 800	530	9.9	6 600	6 000	580	8.8
(ARAB STATES)	(26 500)	(7 500)	(19 000)	(71.6)	(34 300)	(13 600)	(20 800)	(60.5)
FEMALES								
WORLD TOTAL	953 000	525 000	428 000	44.9	1 160 000	692 000	468 000	40.3
AFRICA	77 000	8 800	68 200	88.5	97 900	16 000	82 000	83.7
NORTHERN AMERICA	69 700	67 700	2 000	2.8	82 800	81 200	1 600	1.9
LATIN AMERICA	61 800	39 200	22 600	36.6	82 200	59 700	22 500	27.3
ASIA	488 000	170 000	318 000	65.1	614 000	266 000	348 000	56.7
EUROPE AND U.S.S.R.	251 000	234 000	16 800	6.7	278 000	265 000	12 900	4.7
OCEANIA	5 200	4 500	680	13.0	6 500	5 800	780	11.9
(ARAB STATES)	(26 200)	(2 400)	(23 800)	(90.7)	(33 900)	(4 800)	(29 100)	(85.7)

Compiled by: Office of Statistics, Unesco.

Notes on Table 17

1. The percentage of adults, i.e. persons aged 15 and over who are illiterate, has fallen in the ten-year period between 1960 and 1970 from 39.3% to 34.2% (see Table 14). However, because the total adult population has risen by over 400 million in the same period the actual number of adult illiterates has risen by nearly 50 million. On the other hand the number of adult literates in the world has risen during the ten-year period by over 350 million. It is interesting to note that the 1970 world figure of 783 million illiterate adults is a little more favourable than the earlier projected figure of around 800 million. The reduction in the illiteracy rate between 1960 and 1970 has been somewhat faster than that observed between 1950 and 1960.

2. The highest illiteracy rates are found in Africa and the Arab States followed by Asia and then Latin America and this order has not changed from 1960 to 1970. All four regions lowered their illiteracy rates by between 7 and 9 percentage points during the period. However, this meant that whereas in Latin America their rate was reduced by more than a quarter, in Africa and the Arab States there was a reduction of only 10%.

3. As can be seen in Table 15, the present male adult illiteracy rate is now 28.0% (falling from 33.5% in 1960) whereas the present female adult illiteracy rate is now 40.3% (falling from 44% in 1960). Thus the trend is still for the male rate to fall faster than the female rate and the disparity between the two to increase. The greatest disparity between the male and female rates is in the Arab States followed closely by Africa and the disparity is getting larger in both regions. On the other hand, in Latin America the small disparity is getting even smaller.

(END)